AXIAL AND VERTICAL LAYOUT OF FOREWING ON CANARD CONFIGURATION INFLUENCE OF LONGITUDINAL STABILITY

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This paper focus on the axial and vertical position of front wing influence the longitudinal stability of canard configuration. Use the 3-D vortex lattice software to simulate and calculate.

Themainresearch aim ofthispaperissimulateandcompare the affects, thatwhichkindoflayoutpositionwillinfluence thelongitudinalstability ofcanardconfiguration most.

Compare with conventional aft-tail aircraft, canard main wing is rear of the fuselage, behind the center of gravity. This will make the aircraft pitch nose down when the lift is generated by main wing. In order to counteract this pitching moment, canard wing is placed in the front of the fuselage, ahead of the center of gravity, and producing lift to counteract this pitching moment. This means that the canard configuration aircraft has two surfaces both producing lift.

There are actually two distinct classes of canard:thecontrol-canard and the lifting-canard. In the control-canard, the wing carries most of the lift, and the canard is used primarily for control (as is an aft tail). This thesis will deal mostly with the lifting-canard configuration

Forlayoutposition,therearesixaxialandfourverticalpositionsofcanardwing (see Table 1).

L(m)\H(m)	0	0.3	0.5	0.7
0.5	x	x	x	x
0.9	x	x	x	x
1.1	x	x	x	x
1.0	-	x	x	x
1.5	-	x	x	x
2.0	-	x	x	x

Table 1 Wing geometry

For longitudinal stability, aerodynamic center is one of most important characteristic. If the pitching moment coefficient at each point along the chord is calculated for each of several values of C_L, one very special point is found for which C_M is virtually constant, independent of the lift coefficient. This point is the aerodynamic center.

Thevortexlatticemethod(VLM)isappliedtocomputetheflowaroundawingwithrudimentarygeometricaldefinition.Thevortexlatticemethodisbuiltonthetheoryofidealflow,alsoknownaspotentialflow.

Inthisresearch,weuseTornadotosimulatingtheflowforinvestigatetheaerodynamiccharacteristicsofcanardconfiguration.Tornadoisathree-dimensional-vortexlatticesoftwarebasedonstandardvortexlatticetheory.Therefore,liftcoefficients,induceddragcoefficientsandpitchingmomentcoefficientsarecomputedfordifferentaxialandverticalpositionsofcanardwinganddifferentangleofattack[1]. For start to use Tornado to compute the lift coefficient, drag coefficient, and pitching moment coefficient, first we must input the object wing geometry data in to Tornado. Tornado can simulate and plot the geometry, which shown in following Figure 1.

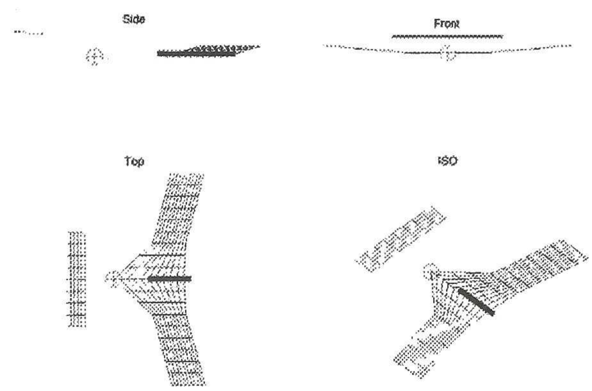

Figure 1 Geometry plot on Tornado

Fromcompute on the Tornado,wecanget21differentaerodynamic characteristics of21differentcanardlayout(see Table 1). After this step, we use least square method to get approximate equations of lift coefficient, induced drag coefficient, and pitching moment coefficient for each 21 different geometry setups, which are shown in following row.

h) There are huge difference of , when we change front canard wing axially. Higher value of axial distance (L) will make value of smaller. On the other hand, influence of vertical distance (H) changes is very small. Higher value of vertical distance (H) can make value of slightly greater, but these changes is very small.

Use these approximate equations, we can draw various coefficient curves in Matlab. From these figure, we can compare curves of nine different geometry setups, and analysis. Andtheresultswillbecomparedwitheach other. Then we can clearly see that axial and vertical position of canard wing difference how to influence the longitudinal stability.

After compare and analysis, we get some conclusions, which shown in following:

a) Growing of axial distance (L) and vertical distance (H) of forewing can slightly increase the , but this difference is very small.

b) Difference of axial distance (L) and vertical distance (H) slightly influence the induced drag coefficient.

c) Use least square method, we obtain the approximate equation of induced drag coefficient, which is shown above. Thus, the value of depends on , and . Growing of Axial distance (L) and vertical distance (H) of forewing can slightly increase the , but slightly decrease the .

d) Growing of axial distance (L) will slightly increase the . Growing of vertical distance (H) will slightly decrease the . But effect that produced is very small.

e) Growing of axial distance (L) and vertical distance (H) of forewing will decrease the value of angle of attack, which is when lift coefficient equal zero.

f) Growing of axial distance (L) and vertical distance (H) of forewing also will decrease the value of angle of attack, which is when induced drag coefficient equal zero.

g) Growing of axial distance (L) will increase the value of angle of attack, which is when pitching moment coefficient equal zero. Contrary to this, growing of vertical distance (H) will decrease this angle of attack.

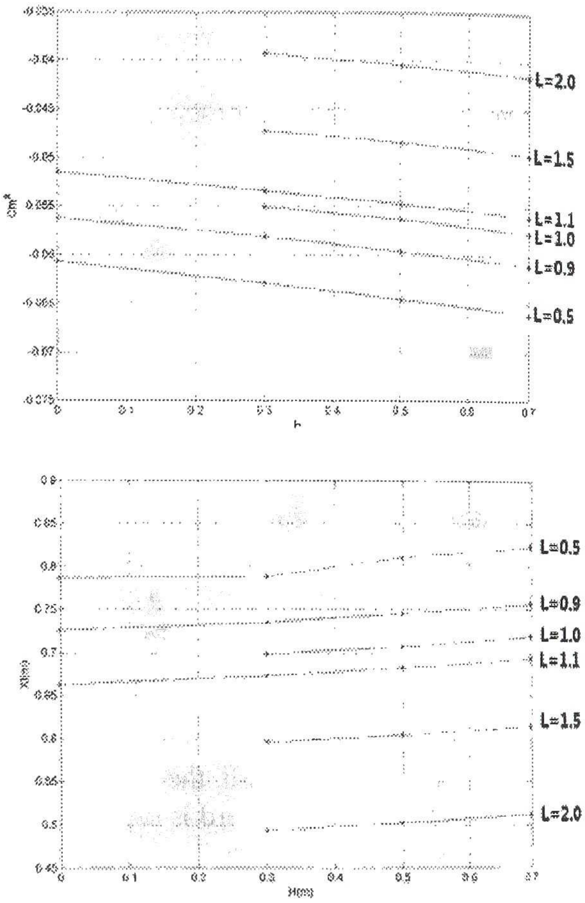

Figure 2 Result of and —

References:

[1] Tomas Melin. A Vortex Lattice MATLAB Implementation for Linear Aerodynamic WingApplications.2000 http://www.redhammer.se/tornado/TBG.html

ФИЗИКО-МЕХАНИЧЕСКИЕ СВОЙСТВА ВСПЕНЕННОГО ПОЛИПРОПИЛЕНА И ЕГО ПЕРСПЕКТИВНОСТЬ ДЛЯ ПРИМЕНЕНИЯ В ЛЕТАТЕЛЬНЫХ АППАРАТАХ

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